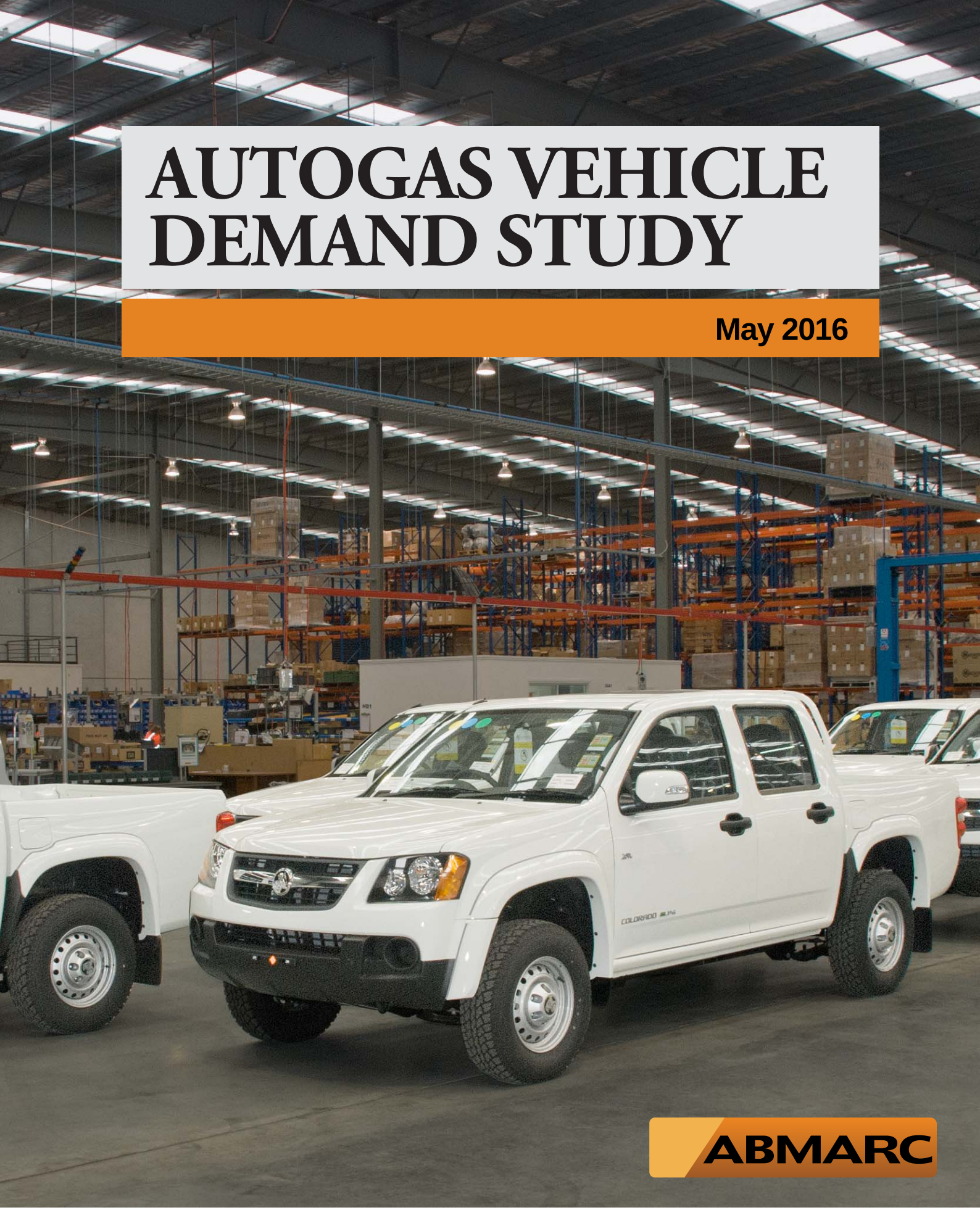
AUTOGAS VEHICLE DEMAND STUDY

May 2016



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EXECUTIVE SUMMARY

Demand Study Overview

The Victorian Automobile Chamber of Commerce (VACC), Gas Energy Australia (GEA) and the Victorian Government's Regional Development Victoria (RDV) are examining the feasibility of developing an autogas engineering design centre, with associated manufacturing and installation facilities for the development and manufacture of autogas cars for the Australian fleet customer.

The *Autogas Vehicle Demand Study* is an analysis of the demand for light duty autogas vehicles (passenger, SUV and LCV) by fleet managers in the Australian market under a range of scenarios and will inform a business case analysis to be conducted at a later date. The study includes autogas vehicles that have been built by OEMs (OEM autogas installations) and vehicles that have the autogas system fitted at a centre of excellence or by an aftermarket installer (conversions). Fleet managers in both the private and government sectors are included in the study.

Demand Study Background

LPG is an indigenous Australian energy source that has been succesfully used as a vehicle fuel (autogas) since the 1970s. It is estimated by GEA that the autogas industry employs approximately 3,600 people Australia wide, of which about 1,700 are based in Victoria.

In recent years, the autogas industry has been in decline. Reducing availability of manufacturer approved or built autogas vehicles, the imminent closure of local passenger car manufacturing, an increasing range of alternative options to autogas and lower petrol and diesel fuel prices have resulted in decreasing sales of autogas vehicles and autogas fuel. An additional challenge for the autogas vehicle market has been the dieselisation of the new vehicle fleet, which has resulted in some vehicle models only being available with a diesel engine. This trend has occurred primarily in the LCV and SUV segments, which had historically provided a large number of petrol cars suitable for autogas application due to their relatively high fuel consumption.

In Europe, a model for the high volume application of autogas to vehicles is in successful operation. Autogas systems in bi-fuel configuration are installed into new vehicles on a production line, which ensures quality and minimises costs. Often vehicle manufacturers support these vehicles by providing customers with full warranty. It is this model of autogas vehicle manufacture that the demand study has been based on.

Methodology

The study consisted of six key research areas which informed the demand models and enabled development of the product price and vehicle model proposals.

Research Areas:

1. Fleet manager survey and focus group
2. Vehicle powertrain technology trends in Australia with global outlook
3. Australian vehicle fleet sales trends
4. Autogas system benchmarking and trends
5. Fuel price trends
6. Autogas SWOT analysis for Australia and Victoria

Deliverables:

1. Product proposal
2. Autogas vehicle price premium
3. Autogas vehicle demand analysis

Demand Model Scenarios:

A number of demand model scenarios were developed being:

1. Business as Usual
   Autogas Manufacturing Centre and:
2. Excise and fixed $2,500 price premium
3. Excise & variable autogas vehicle price premium calculated on a 3 year payback with a $1,800 minimum price
4. No Excise and fixed $2,500 price premium
5. Technology – High EV uptake, no excise and $2,500 price premium
6. CO_2 Regulation – Excise and $1,300 price premium

Price premium is defined as the additional cost of the autogas vehicle to a petrol car of comparative specifications and performance.

Technology, energy price and vehicle segment trends were analysed and forecasts developed, with the overall assumptions underpinning each scenario shown below. Autogas vehicle price premiums have been established based on knowledge of autogas system costs, CO_2 reduction technology costs, and pricing to meet market requirements. The actual price premium of autogas vehicles will be dependent on the economics of the business case for the autogas centre of excellence.

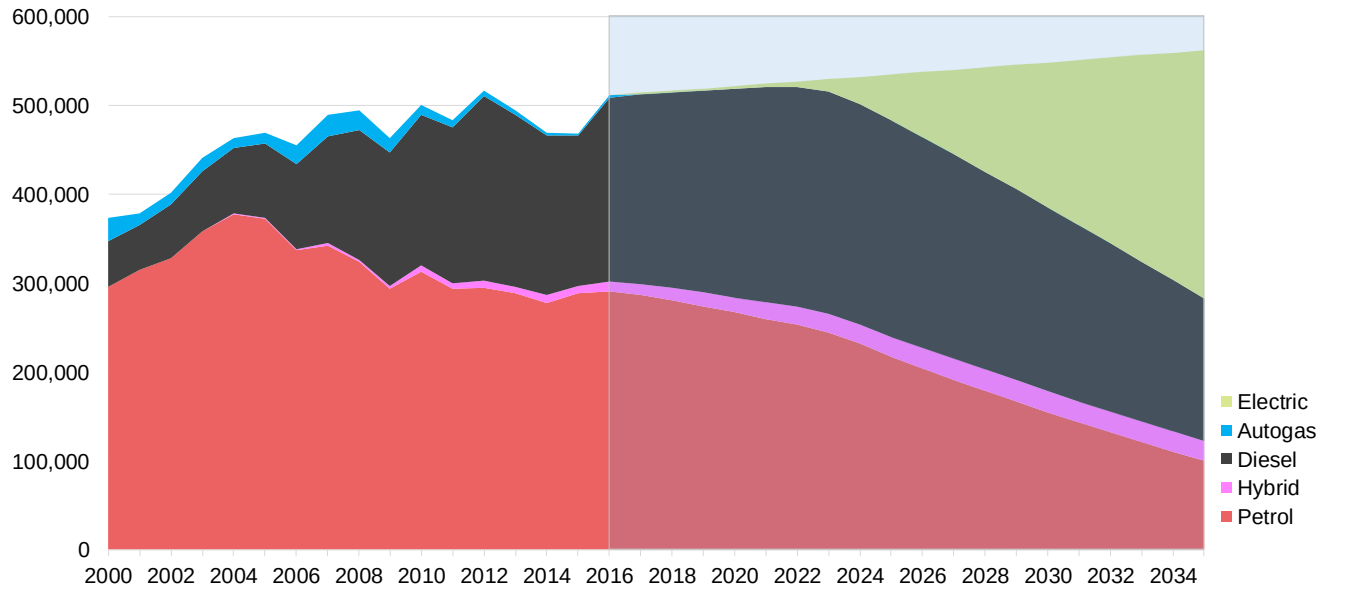
Model Assumptions

		Scenario					
		1	2	3	4	5	6
General Assumptions	Autogas vehicle sales coupled to models available	✓	✓	✓	✓	✓	✓
	Fleet vehicle sales grow by 0.5% annually	✓	✓	✓	✓	✓	✓
	New ICE light vehicle CO_2 emissions & fuel consumption improves by 2.4% per year	✓	✓	✓	✓	✓	✓
	No OEM built or warranted autogas vehicles available post 2016	✓					
	Autogas manufacturing centre exists		✓	✓	✓	✓	✓
	Autogas to petrol price differential does not change over time	✓	✓	✓	✓	✓	✓
	Fleet vehicles travel an average of 20,000 kms per year	✓	✓	✓	✓	✓	✓
	Autogas payback period - 3 years or less	✓	✓	✓	✓	✓	✓
Fleet Mix	Continuing Shift from passenger to SUV & LCVs, plateauing at 35% passenger vehicles	✓	✓	✓	✓	✓	
	Shift back from SUV & LCVs to passenger vehicles, plateauing at 46% passenger vehicles						✓
Other	10 Passenger and 10 SUV/LCV autogas models available in 2018		✓	✓	✓	✓	✓
	CO_2 regulated limits of 154 g CO_2/km in 2020 and 119 g CO_2/km in 2025						✓
EV Uptake	Baseline EV uptake - EV sales 10% in 2025, 30% in 2030 and 50% in 2035	✓	✓	✓	✓		
	Mid range EV uptake - EV sales 13% in 2025, 40% in 2030 and 60% in 2035						✓
	High EV uptake - EV sales 30% in 2025, 50% in 2030 and 60% in 2035					✓	
Price Premium	$2,500 price premium		✓		✓	✓	
	Variable price premium, minimum $1,800, to meet 3 year payback period			✓			
	$1,300 price premium						✓
Autogas Excise	Excise remains		✓	✓			✓
	Excise removed				✓	✓	

Summary Results

Autogas Vehicle Demand

Under a business as usual (BAU) scenario, sales of autogas vehicles to fleets will cease in 2018. Total fleet vehicle sales under Scenario 1, BAU are shown below in Figure 1:



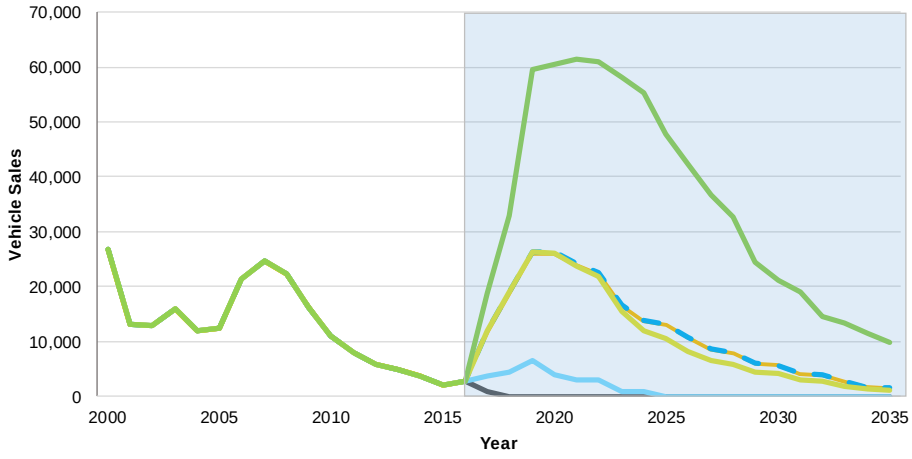
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Forecast Sales	2,001	2,695	740	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market Share	0.4%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Figure 1 - Scenario 1 BAU.

In all other scenarios, autogas sales peak between 2019 and 2021, before declining over time. The key reasons for autogas sales reducing post 2021 under each scenario are:

- The underlying fuel consumption improvements being made to conventional internal combustion engines (ICE) that has the effect of reducing the number of vehicles suitable for application of autogas.
- The development and commercialisation of electric vehicles that are forecast to be cost competitive to internal combustion engine powered vehicles from 2025.

Under Scenario 3; with an autogas manufacturing centre of excellence and a variable autogas vehicle price premium ($1,800 minimum), the sales of autogas cars peak in 2019 at 26,014 sales. In Scenario 4 and 5, an autogas vehicle price premium of $2,500 and the excise removed from autogas, the demand for autogas cars peaks in 2019 at 26,286 and 26,259 respectively. The demand for autogas vehicles is highest under Scenario 6, with a CO_2 regulation in place that enforces limits on fleet average CO_2. Sales of autogas vehicles in Scenario 6 peak in 2021 at 61,511.



	PEAK	2025	2035
Scenario 1.		0	0
Scenario 2.	6,597 (2019)	0	0
Scenario 3.	26,014 (2019)	13,008	1,500
Scenario 4.	26,286 (2019)	13,153	1,512
Scenario 5.	26,259 (2019)	10,487	1,173
Scenario 6.	61,511 (2021)	47,702	9,803

Chart 1 - Total Fleet Autogas Sales Forecast

Cumulative autogas vehicle sales from 2018 to 2025 exceeds 160,000 in scenarios 3, 4, and 5 and 430,000 under scenario 6. It is possible that an autogas manufacturing centre may be viable with as few as 5,000 vehicles/year.

Price Premium and Vehicle Model Proposal

The top five best selling fleet vehicles suitable for autogas application (based on payback period and sales volume) have been selected. This list comprises three passenger cars and two SUVs. The number of sales of each model to fleets in 2014 is indicated on the bar chart shown below in Table 1.

The maximum price premiums have been established based on a payback period of three years at 20,000km per year and Australian capital city average fuel prices (excluding Darwin and Hobart). An autogas vehicle price premium calculated with and without excise has been presented.

In order for autogas vehicle sales to be successful, either the price differential between petrol and autogas fuel needs to be increased, which could be achieved with the removal of the excise on autogas, or the autogas system cost needs to be reduced to achieve the maximum 3 year return on investment required by the majority of fleet managers.

Make & Model	Engine Variant	Fuel Delivery	Proposed Autogas System	Price Premium Based on 3 yr Payback Period (with Excise)	Price Premium Based on 3 yr Payback Period (without Excise)
Toyota Corolla Passenger	1.8L/4-Cyl	PFI	Bi-Fuel - Vapour PFI Seq. Inj.	$ 1,803.00	$ 2,540.00
Hyundai i30 Passenger	1.8L/4Cyl	PFI	Bi-Fuel - Vapour PFI Seq. Inj.	$ 1,940.00	$ 2,732.00
Toyota Camry Passenger	2.5L/4-Cyl	PFI	Bi-Fuel - Vapour PFI Seq. Inj.	$ 2,131.00	$ 3,001.00
Toyota Kluger SUV	3.5L/6-Cyl	PFI	Bi-Fuel - Vapour PFI Seq. Inj.	$ 2,787.00	$ 3,925.00
Hyundai ix35 SUV	2.0L/4-Cyl	DI	Bi-Fuel - Vapour PFI Seq. Inj. Or Bi-Fuel - Autogas DI	$ 2,295.00	$ 3,232.00

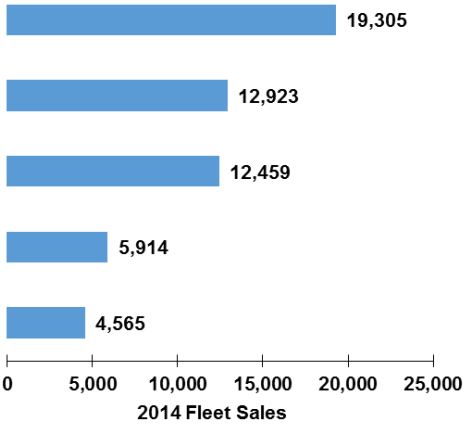


Table 1 – Top Five Vehicles Proposed for Autogas System Installation

Note: Engine compatibility to operate on autogas needs to be confirmed by key engine component and material analysis

SWOT Summary

There are advantages in operating an autogas powered vehicle over petrol and diesel alternatives, and opportunities to enhance their uptake. However, there are weaknesses and threats that should be addressed in order for autogas cars to be a viable vehicle alternative today and in the future.

STRENGTHS

- Australian fuel resource availability (indigenous fuel)
- Fuel availability at service stations (infrastructure), greater than 60% and particularly in Victoria with approximately 75%
- Extensive installation, repair and maintenance network
- CO_2 reduction compared to equivalent petrol vehicle
- CO_2 benefit compared to electric vehicles operated in Victoria, NSW and QLD (when not using green power)
- Lower operating costs compared to equivalent petrol vehicle
- Increased range of bi-fuel autogas vehicle compared to the base fuelled vehicle
- Significantly lower PM and NOx emissions than diesel vehicles (improved air quality)

WEAKNESSES

- Higher vehicle price compared to equivalent petrol vehicle
- Negative perceptions by some in the community towards autogas vehicles
- Reduced operating cost competitiveness due to introduction of 50% excise rate
- Lack of choice in OEM built or approved autogas vehicles in the market
- OEMs, Ford and Holden ceasing production of autogas vehicles in 2016 and 2015 respectively

OPPORTUNITIES

- Autogas vehicles with a payback of 3 years or less are of interest to fleet managers
- Mandatory fleet vehicle CO_2 targets could increase demand for autogas vehicles
- 2016 regulation and policy review by the Federal Government covering; vehicle emissions, fuel quality standards, CO_2 regulation and policies to promote alternative vehicle technologies
- Utilisation of grant schemes such as the Automotive Transformation Scheme (ATS) or Automotive Diversification Programme to support the establishment of an autogas vehicle manufacturing centre
- Australian content requirement in Government procurement policies
- Air quality benefits of autogas compared to diesel (particulates and NOx)
- Providing energy security
- Employment, innovation and manufacturing opportunities
- Education of fleet managers to increase their knowledge of autogas benefits

THREATS

- Ageing refuelling infrastructure not being replaced and autogas infrastructure not being installed on many greenfield service station sites
- Emergence of price competitive electric vehicles from 2025
- Underlying continued improvement of fuel economy of internal combustion engines
- Hybrid vehicle technologies and diesel only model variants

Fleet Managers' Survey

An online survey of Fleet Managers was conducted to understand fleet trends, Fleet Manager thinking and corporate vehicle policies, in order to identify opportunities and weaknesses of the autogas vehicle product offering. Both quantitative and qualitative methods were used in the survey methodology.

Survey sample size: 93 complete with an additional 44 partial responses, making a total of 137 responses to the survey. The 93 complete survey respondents were responsible for managing a total of 41,055 passenger and light commercial or sports utility vehicles. It is estimated that the survey and focus group participants' new vehicle purchases account for more than 2.7% of annual fleet vehicle sales.

- The most popular autogas vehicle was a passenger car, purchased new with a dual fuel autogas system already installed. 23% of fleet managers responded that they would definitely consider this vehicle type, and this rate increased to 40% for Victorian fleet managers.
- Respondents passenger vehicle fleets consisted of 15% autogas powered cars. Fleet managers believed that in 5 years time, their fleets would still consist of 15% autogas powered passenger vehicles. This indicates that if available, fleet managers are likely to keep autogas cars in their vehicle mix.
- In order, the top four most important vehicle purchase considerations were:
    1. Fit for purpose [96%]
    2. Vehicle safety [92%]
    3. Vehicle price [84%]
    4. Vehicle operating costs [82%]

  These responses include the rating "extremely important" and "very important". Vehicle price and operating costs may be concluded as 'vehicle whole of life expenses'.
- 51% of fleet managers responded that a vehicle price premium over an equivalent petrol car should be paid back within 2 to 3 years. This corresponded to vehicle fleet replacement of 3 years by 53% of fleet managers replacing their passenger cars and 35% of fleet managers replacing their SUV/LCV fleet.
- Fleet managers were asked what other buying considerations might make them more likely to purchase an autogas vehicle and their top two responses in order were:
    1. Government supporting the uptake of vehicle type through incentives such as registration price reductions or preferential changes to stamp duty [27% definitely]
    2. Autogas vehicles come with an all inclusive warranty that equals the manufacturer's [25%]
- One third of companies surveyed had a formal CO_2 reduction policy and target in place, with about 45% of those requiring reductions of between 4% and 5% CO_2 each year.

Conclusion

There is an underlying demand for autogas vehicles in the fleet segment, particularly in Victoria, providing that the return on investment can be achieved within three years. Under a business as usual scenario, it is forecast that autogas vehicle sales to fleets will cease in 2018 due to a lack of vehicle availability.

Without fleet average CO_2 regulation, Scenarios 3 and 4 provide the best opportunities for autogas vehicles. Under Scenario 3, if an autogas manufacturing centre is established and vehicles are priced to achieve a 3 year return on investment, with a minimum $1,800 premium above a comparative petrol car, sales are forecast to peak at 26,014 in 2019 before declining again. Scenario 4 removes the excise on autogas fuel, has a fixed $2,500 autogas system cost and forecasts sales peaking in 2019 at 26,286. In both instances, the cumulative sales from 2018 to 2025 exceeds 160,000 vehicles. Sales of OEM autogas vehicles throughout the early 2000s often exceeded 30,000 per annum.

The significant challenge for autogas vehicles is the underlying fuel economy improvements of approximately 2.4% per year being achieved across the Australian new vehicle fleet. This has the effect of reducing the number of vehicles suitable for autogas application due to increasing average payback periods. In addition, there is a threat from electric vehicles as they are likely to take significant market share from conventional vehicles from 2025.

Under scenarios 3 to 6 there is at least a 15 year window of opportunity and scenario 2, provides 8 years of opportunity for autogas vehicles to make a significant contribution to the Australian vehicle fleet to; reduce fleet average CO_2, provide increased energy security, local manufacturing, local job opportunities and support the continuation of existing autogas infrastructure and sector employment.

Key Recommendations

1. For the report stakeholders to develop an engagement strategy to communicate the results of the *Autogas Vehicle Demand Study* to potential investors of a manufacturing centre of excellence
2. Conduct a business case analysis for an autogas vehicle engineering design centre, with associated manufacturing and installation facilities, based on the results of the demand modelling and investor interest
3. Conduct autogas vehicle demand modelling on private sector vehicle sales (that is, non-fleet vehicles)

If the business case analysis supports the establishment of the autogas centre of excellence, the following recommendations' aims are to achieve conditions that make it attractive, from a financial or environment perspective, for fleet operators to utilise autogas cars in their fleets:

4. When developing CO_2 fleet regulation and vehicle procurement policies, State and Federal Governments should recognise the benefit that autogas vehicles provide in reducing tailpipe CO_2 emissions, by approximately 12% over a comparative petrol car
5. Recognise that autogas vehicles can play an important role in the transition from conventional fossil fuel powered vehicles to fully commercialised and cost competitive electric cars, whilst using an indigenous and lower carbon fuel source
6. Utilise the 2016 regulation and policy review being conducted by the Federal Government covering; vehicle emissions, fuel quality standards, CO_2 regulation and policies to promote alternative vehicle technologies, as an opportunity to maximise Australian R&D and manufacturing
7. Consider utilisation of existing monies in schemes such as the ATS, to support the establishment of the autogas centre of excellence
8. To minimise the impact of the closure of a significant part of the automotive manufacturing industry and the threat of another 1,700 jobs in the autogas sector over the next 10 years, the Victorian Government could consider support of autogas vehicles through their Automotive Transition Programme and favourable stamp duty or vehicle registration arrangements to promote their uptake

ACRONYMS & ABBREVIATIONS

ACT	Australian Capital Territory
ANCAP	Australasian New Car Assessment Program
AWD	All Wheel Drive
Carb.	Carburettor
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DC	Direct Current
DI	Direct Injection
DOEM	Delayed Original Equipment Manufacturer
EDR	Economic Demonstrated Resource
EOBD	European On-board Diagnostic
EPA	Environmental Protection Agency
EU	European Union
EV	Electric Vehicle
GEA	Gas Energy Australia
HPP	High Pressure Pump
ICE	Internal Combustion Engine
km	Kilometres
LCV	Light Commercial Vehicle
LPG	Liquefied Petroleum Gas
LPGVS	Liquefied Petroleum Gas Vehicle Scheme
MY	Model Year
MPI	Multi Point Injection – also referred to as Port Fuel Injection (PFI)
N/A	Not Applicable
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NSW	New South Wales
NT	Northern Territory
OBD	On Board Diagnostic
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
Opt.	Option
PFI	Port Fuel Injection
PM	Particulate Matter
PN	Particulate Number
QLD	Queensland
QR	Quick Response matrix barcode
RDV	Regional Development Victoria
SA	South Australia
SUV	Sport Utility Vehicle
SWOT	Strengths, Weaknesses, Opportunity and Threats
TAS	Tasmania
THC	Total Hydrocarbons
US	United States
USD	US Dollar
VACC	Victorian Automobile Chamber of Commerce
VIC	Victoria
VSI	Vapour Sequential Injection
VW	Volkswagen
WA	Western Australia

GLOSSARY OF TERMS

After-market conversion is a vehicle that has had an autogas system installed by an autogas installer. These systems are not supported or warranted by vehicle manufacturers.

Autogas is liquefied petroleum gas fuel for automotive use, also known as LPG.

Bi-Fuel is a vehicle which operates on two fuels simultaneously such as autogas and petrol or diesel.

Confidence interval is also called the margin of error. For example, a confidence interval of 10, with 100 respondents and 50% of respondents selecting a certain answer, one can be confident that between 40% and 60% of the entire population would have picked this answer.

Confidence level is how confident one can be that the confidence interval is correct. To apply this to the confidence interval example as above, having a confidence level of 95% means one can be 95% sure that 40% to 60% of the entire population would pick the same answer from the given selection.

Demand capacity refers to autogas manufacturing operations that are able to meet demand.

Electrolysis is a process that uses a direct electric current (DC) to initiate an otherwise non-spontaneous chemical reaction.

Fleet market includes vehicles sold to both the private business and government sectors.

Hybrid vehicles are defined as a vehicle that combines an internal combustion engine with batteries and an electric motor. For the purpose of this report, vehicles that use energy storage technologies, such as, Kinetic Energy Recovery Systems (KERS) have not been included as a hybrid vehicle in the forecast scenarios.

LPG in this report is used when referring to liquefied petroleum gas resources or LPG that is not exclusively for use in vehicles.

Manufacturing centre or Delayed OEM, describes a production line that delivers high volume installation of autogas systems into new vehicles, ensuring quality and minimising costs. Often vehicle manufacturers support such installations with full warranty. It is this model of autogas vehicle manufacture that the demand models have been based on.

Mono-Fuel is a vehicle which operates exclusively on one fuel, in this report it refers to a mono-fuel autogas vehicle. Mono-fuel vehicles can also be referred to as dedicated or single fuel vehicles.

Naturally aspirated engine is an internal combustion engine in which the air intake depends solely on atmospheric pressure and does not utilise forced induction, such as turbocharging or supercharging.

Price premium is defined as the additional cost of the autogas vehicle to a petrol car of comparable specifications and performance.

Qualitative data is not directly measured, it is gathered through open ended questions and discussion. Qualitative data provides more understanding of the quantitative data. For example, qualitative information will reveal *why* fleet managers are concerned about the environment, but not the number of fleet managers that are concerned.

Quantitative data is measured and can be expressed as a value. For example, 70% of fleet managers are concerned about the environment.

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